

REMARKS

Claims 1, 3-7, 9-12, 23-27 and 38-40 are pending. Claims 13-22 and 28-37 have been canceled pursuant to the Examiner's Restriction Requirement. Applicants note that misnumbered claims 28-29 have been renumbered as 38 and 39. Support for new claim 40 may be found in the specification, page 14, lines 13-20.

The rejection of claims 23-27 under 35 U.S.C. § 112, second paragraph, has been obviated by amending these claims in accordance with the Examiner's suggestion.

Claims 1, 5, 7 and 11 were rejected under 35 U.S.C. § 102(a) as anticipated by JP 8-104510. This rejection is respectfully traversed and reconsideration is requested for the reasons that follow.

The present invention is directed to a carbon material wherein edge parts of the core carbon material are partially or entirely coated with a coat-forming carbon material, the carbon material being nearly spherical or ellipsoidal. The carbon material has a specific surface area determined by a BET method of $5\text{m}^2/\text{g}$ or less. The invention is also directed to a method of manufacture of the carbon material. The specification provides a comparison of particles prepared in accordance with the invention (example 1) and those of the prior art which are a pulverized or crushed carbon material (comparative example 5). As described below, the comparison shows that the carbon materials in comparative example 5 are not nearly spherical or ellipsoidal and, therefore, do not meet the limitations of the claims.

Tap density of particles prepared according to example 1 and comparative example 5 of the specification are determined using the following conditions:

Apparatus: TAP DENSER KYT-3000 (SEISHIN KIGYO K.K.);

Measurement Cell: 100cc;

Stroke: 50 mm.

The results are shown in the following table:

Table A

	Tap density (g/cc)	
	Number of tapping = 0	Number of Tapping = 1200
Example 1	0.527	1.001
Comparative Example 5	0.326	0.604

Table A demonstrates that the particles of example 1 with higher tap density are more spherical or ellipsoidal than the particles of comparative example 5 with lower tap density.

Discharge capacity and efficiency of charge and discharge concerning example 1 and comparative example 5 are extracted from table 2 of the specification and shown in table 2A below.

Table 2A

	Discharge capacity (mAh/g)	Efficiency of charge and discharge (%)
Example 1	355	83.4
Comparative Example 5	302	68.1

Comparing example 1 with comparative example 5 in efficiency of charge and discharge, it can be seen that decrease of efficiency of charge and discharge in

comparative example 5 is due to decomposition of electrolyte on the surface of grinding face of the carbon material prepared in comparative example 5.

For the Examiner's convenience, partial English translations of JP 8-104510 are provided below:

English translation of claim 3 of JP 8-104510:

“Claim 3. The method for preparation of a carbon composite material according to claim 1, characterized in that the method further comprises the third process of crushing or pulverizing a product of the second process to classify the resulting powder to prepare the carbon composite material having a volume average particle diameter of not more than 35 μm .”

English translation of page 4, column 6, lines 37-46 of JP 8-104510:

“The product from the second process to be placed in a reactor may be subjected to a necessary pretreatment step such as processing of its shape, specifically pulverization, crushing or adjustment of particle size by granulation.

(5) The fourth process: Powder processing process

The product of the third process in which a residual heavy oil was carbonized in such a manner that all or part of the surface of the core carbonaceous particle was covered with the carbonized heavy oil to form a composite material is optionally subjected to a powder processing process, such as pulverization, crushing, classification step.”

English translation of page 5, column 8, lines 40-44 of JP 8-104510 which is a part of example 1:

“(4) Powder processing process

Since the heat-treated product, which was a composite material consisting of carbonaceous particle and carbonaceous coating layer, was partially fused among particles, the product was crushed into primary particles with a roll crusher to give a carbon composite material powder having a average volume particle diameter of 21 μm .”

As shown above, JP 8-104510 discloses a carbon composite material which is crushed or pulverized after a carbonation process, since particles are fused by the carbonation process. Crushed particles having grinding faces are not nearly spherical or ellipsoidal. Since the carbon composite material of JP 8-104510 does not have a nearly spherical or ellipsoidal shape, the present claims clearly cannot be anticipated by JP 8-104510.

Claims 1, 3-5, 7, 9-11, 23, 38 and 39 were rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103 as obvious over Miyabayashi et al. Claims 6 and 12 were rejected under 35 U.S.C. § 103 as unpatentable over Miyabayashi et al. These rejections are respectfully traversed and reconsideration is requested for the reasons that follow.

The carbon material of the invention can be used as active material for a battery. Important properties required for carbon material used as active material for a battery are:

(i) higher capacity for charge and discharge which can contribute to increased capacity in batteries;

- (ii) lower irreversible capacity at an early stage of charge and discharge.

Carbon material usually has a certain degree of irreversible capacity; and

- (iii) Easy preparation of paste for producing electrodes. Tap density is one of the relevant physical properties on ease of paste preparation. A negative electrode can be prepared by mixing an active material for negative electrode, binder and solvent to prepare a paste, followed by spreading the paste on a metal foil. Higher tap density makes it possible to reduce the amount of both binder and solvent, leading to an increase of a proportion of active material.

As shown on page 4, lines 11-21 of the specification, covering (core) graphite particles in liquid phase with amorphous carbon derived from decomposed organic compounds by calcination results in fused and aggregated carbon particles. The fused and aggregated carbon particles must be crushed or pulverized, and then classified before use as an active material. The prior art crushing or pulverizing process produces a grinding surface which causes decomposition of electrolyte and a decrease in performance of the carbon material. In other words, inhibition of aggregation or fusing of carbon particles during calcination is important to exhibit full performance of the amorphous-coated graphite material.

According to the invention, higher crystallinity core graphite is covered with lower-crystallinity amorphous carbon material to inhibit reactivity of higher-crystallinity core graphite. Since the crystallinity of the carbon material is proportional to capacity of discharge thereof, it is preferable to cover core higher-crystallinity graphite with the least amount of lower-crystallinity amorphous carbon material to improve capacity of

discharge. With respect to the invention, a spherical or ellipsoidal shape is one of the preferred forms to cover a core material efficiently leading to carbon material with no reactivity and high capacity of discharge. If the carbon material with no active surface of core graphite is prepared by crushing or pulverizing fused and aggregated carbon particles, the carbon material must be covered with a large amount of amorphous carbon to be capable of crushing fused particles within a thick amorphous layer, leading to undesirable amorphous-rich carbon material. According to the invention, amorphous carbon material content is usually about 10% (9% in example 1), and 30% (example 19) is maximum. In contrast, according to EP 0 549 802, amorphous carbon material content is 50 wt. % in example 1, 47 wt. % in example 2, and 35 wt. % in example 3. Such a large amount of amorphous carbon is necessary to inhibit generation of active surface of core material during a crushing or pulverization process. Accordingly, the rejection of the claims as anticipated by or obvious over Miyabayashi et al. are clearly inappropriate and should be withdrawn.

In view of the foregoing, this application is in condition for immediate allowance.

Favorable consideration is respectfully requested.

Respectfully submitted,

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A handwritten signature in cursive script, reading "Linda R. Poteate", written over a horizontal line.

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